ing procured from foul or stagnant water. In this case the opinion of M. Dutertre, that the liver of poisonous mussels is the seat of disease and the generator of the poisonous leucomaine, seems confirmed; but I cannot agree with the French observer, that the disease is never the result of the poisonous nature of the food of the mussel. I have read all, or nearly all, the cases of mussel-poisoning on record, and I gather from such details as are given with respect to the places in which the mussels were found that they were in contact with sewage or stagnant water."

RECENT THEORIES OF GEOMETRICAL ISOMERISM.[1]

THE histologist places a section of organized tissue upon the stage of his microscope, and studies its structure. He reports upon the cells and their contents, for he has seen them, but he has not detected the molecule. The smallest discernible particle was probably an aggregate of at least a million molecules of elaborate structure, permeated by many times as many molecules of simpler composition.

The actual configuration of atoms in the molecule, the bonds by which they are united, the mechanism which effects transformations from one form to another, and, indeed, the very existence of molecules, are subjects which do not belong to the world of sight. It is not likely that any human eye, with the most perfect optical instruments, will ever penetrate these secrets of an unseen world.

But the many unseen worlds are favorite hunting-grounds of science. The imagination of the geologist sees successive strata in regular order or thrown into folds, where the rocks are hidden from the uninitiated by drift, soil, and forest, or even where they were long since removed by erosion. The astronomer, having discovered a simple law controlling the motions of the planets, pursues them with the formulas of dynamics and perturbations, until the unexplained residuals of motion lead him to the very spot occupied by Neptune. The biologist experiments upon the vitality of invisible germs, but the chemist reasons upon the elements that make up molecules of which these germs consist. He recognizes atoms having simple, double, triple, and quadruple power of union. Whatever be the nature of this union, the "bonds" are as real as ever held prisoner to Roman soldier. The structural formulas which characterize the language of modern chemistry express the fact that each atom is specially related to a certain one or more other atoms, with scarcely the least claim in regard to distance or direction.

The doctrine of valence and types prepared the way for the more elaborate doctrines embodied in structural formulas, which so admirably explain numerous re-actions and isomers. Such is our ignorance of the actual relations of the atoms in space, that no photographs of geometrical isomers can be offered for inspection; yet certain working hypotheses of their configuration, which were received for some years with great reserve, have recently had such influence in shaping the current of research in organic chemistry, that they are well worth our attention at this hour.

When the quadrivalent character of carbon was distinctly recognized, as in CH_4, it was probably not long before the regular tetrahedron often occurred to thinking minds as a suitable representation. If CH_4 thus represents the outline of a regular tetrahedron, it must not be supposed that the actual form is changeless, but rather that the mean positions of the hydrogen atoms are at the angles. In substitution products, we may think of the several radicles oscillating about mean positions that are at unequal distances from each other, the mutual attraction of the most unlike groups bringing them somewhat towards each other. The conditions in the two forms (see below) are so far identical that the mean mutual distance of any pair of groups will be the same in both. The difference would not be likely to make one form more easily soluble or volatile than the other. The usual means of distinguishing isomers may fail. Ordinary methods of fractional distillation or precipitation are alike useless to distinguish tweedledum and tweedledee. A most delicate instrument, capable of feeling the slightest resistance to the vibrations of luminiferous ether, is found in a ray of polarized light. When such a ray passes through the asymmetric molecule, it is probable that greater resistance will be met in some one plane than in another, and thus the plane of polarization is slightly turned. In a fluid aggregate, a ray will meet successive molecules in all possible positions; and while these must have unequal effects,—sometimes, perhaps, in opposite directions,—the mean result for a large number will always be the same.

Le Bel and van't Hoff were the first to state clearly (and independently) the fundamental principles upon which this branch of chemical investigation has been developed. In the first place, when carbon is linked with four different radicles, two isomers will usually result, the forms of the molecule being related to each other as an object to its image in a plane mirror. These isomers closely resemble each other in most physical and chemical properties. Two such atoms may be represented by tetrahedrons, united at the corners, where it is important to note the cyclical order of the radicles attached to each carbon atom as seen from that atom itself.

Our theory must conform, however, to the observed facts; otherwise we may either be overwhelmed with a multitude of imaginary isomers, or we may be unable to account for all that are discovered. The following principle (which has been known as "van't Hoff's second hypothesis") is supported by many facts: When two atoms of carbon are united by a single bond, each is capable of free rotation in either direction about the common axis; and isomers may be recognized for those bodies only which cannot be brought into the same configuration by such rotation. But some apparent exceptions must not be ignored, especially a marked exception to the principle of free rotation, announced two years ago by Auwers and V. Meyer.

Again, using the tetrahedron as the symbol of the carbon atom, we may conceive two such forms united on a common edge, with hydrogen at the four free corners, to represent the molecule of ethylene (C_2H_4). In like manner, acetylene derivatives may be represented by two tetrahedrons with a common face.

Finally the theory of rings was discussed. A campaign is thus being conducted towards the stronghold of atomic mysteries.

The current theories of stereochemistry or geometrical isomerism are based upon those residuals of observed facts that find no explanation in the usual doctrine of structural formulas. Any complete bibliography, covering all the experimental evidence that may bear upon this subject, must therefore include all reactions or properties that aid us in determining the constitution of the many compounds capable of appearing in geometrical isomers. In the list appended to Professor Warder's paper an attempt is made to include those papers only that may be most useful to chemists or physicists desiring to acquaint themselves with the history of the stereochemical conception, its originators, supporters, and opposers. The full value of Professor Warder's paper cannot be appreciated without the use of the many diagrams which are not available for our use.

[1] Abstract of an address before the American Association for the Advancement of Science, by Robert B. Warder, vice-president of Section C.

NOTES AND NEWS.

THE pressure of natural-gas wells in Indiana and Ohio is steadily diminishing, the diminution having already amounted to between 30 and 40 per cent. Professor Orton urges the imperative necessity of cities and States taking action to restrict wasteful use of gas; but even the strictest regulations, he says, cannot prevent the exhaustion of the supply in a few years. In this connection, says the *Engineering and Mining Journal*, it is interesting to note that the Pennsylvania Company has taken the step of refusing to sell natural gas in Erie, Penn., except by metre, charging 22½ cents per 1,000 cubic feet, in order to prevent waste of the gas. No factories are to be furnished at any point on its line, as all the gas will be used for domestic purposes.

—The American Folk-Lore Society will hold its annual meeting in New York City on Nov. 28 and 29, these dates being the Friday and Saturday following Thanksgiving Day. The sessions will be held at Columbia College, in rooms kindly placed at the disposition of the society by President Low. Last year the annual